AMEBIC DYSENTERY IN CALIFORNIA*

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The conditions of the war have greatly increased the amount of attention given to the intestinal protozoa of man, of which Endamoeba dysenteriae, Giardia intestinalis, Trichomonas intestinalis, and Balantidium coli are the most important. During the past 3 years, army medical journals and the journals of the schools of tropical medicine have devoted much space to the publication of the results of investigations of the problems of incidence, spread (especially by cyst carriers), diagnosis, and treatment of the respective diseases caused by these organisms. One of the most significant outgrowths of this work is the decided addition to the already accumulated evidence that amebiasis is by no means restricted to the tropics but can become and is becoming constantly more widely established in countries of the temperate zones. The problem of the danger of the spread of amebiasis and giardiasis by returning troops is receiving especial consideration in England, and English physicians have found that many returning soldiers had acute dysentery, or were discharging the cysts of E. dysenteriae. A special study of 20 "cyst carriers" was made by members of the staff of the Liverpool School of Tropical Medicine.[1] Of the twenty, 14 had contracted the disease in France, and 10 of these in the region of the Somme. Two had had the disease before, one in South Africa and one in Gallipoli. Probably the first diagnosis of amebic dysentery in the United States was made in 1890 (Osler[2]). Since then an increasing number of cases have been reported each year in medical literature. Ten years ago Patterson[3] reported amebic dysentery from 24 different states and the District of Columbia. Since that time many states have been added to this number until now nearly

Received for publication July 22, 1919.

* Reprint Series, Division of Parasitology, California State Board of Health, Vol. 1. No. 8.

[1] Carter, H. F.; Mackinnon, D. L.; Matthews, J. R., and Smith, A. M.: Ann. Trop. Med. & Parasit., 1917, 11, p. 27; Yorke, W.; Carter, H. F.; Mackinnon, D. L.; Matthews, J. R., andSmith, A. M.: ibid., p. 87.

[2] Med. News, 1902, 15, p. 673.

[3] Am. Jour. Med. Sc., 1909, 138, p. 198.

every one of the 48 is included. Many of the states reported by Patterson were among the most northern, as Maine, New York, Ohio, Minnesota and Montana. The work of Smithies[4] in making 1,000 routine examinations for intestinal protozoa gives an insight into the conditions in the United States at the present time regarding the incidence of intestinal protozoa. Of entameba, both histolytica and tetragena stages, there were 23 cases, while infections with Cercomonas, Trichomonas, Giardia (Lamblia), Megastoma, and Balantidium made a total of 93 persons harboring protozoa. The distribution of these cases is significant, for of the 13 different states of which these infected persons were residents, 9 are entirely north of the latitude of the Ohio river. One of these cases was from northern California.

In 1909, Long[5] discussed the dangers to California from amebic dysentery. His attention was called to this subject by the admission, during 1907 and 1908, of 4 cases of this disease into the U. S. Marine Hospital, San Francisco. In all 4 of these cases, the disease appeared to have been contracted in San Francisco. In fact, one was a man who had never been out of the city This led Long to institute routine fecal examinations for amebas. As a result of these examinations, between Dec., 1908, and June, 1909, he diagnosed 40 cases of amebic dysentery. Fourteen of these he believed had originated in the United States. In a paper by Gunn[6] is the following significant sentence: "In nine of the twenty-one cases herein reported the disease was contracted in California."

In order to secure some further insight into the seriousness of the protozoan dysentery problem in California, the Division of Parasitology of the California State Board of Health sent a circular letter to 45 hospitals at widely distributed points throughout the state. In this letter inquiry was made whether cases of amebic or flagellate dysentery had been diagnosed recently. Whenever such cases were found, an attempt was made to obtain as much as possible of the case history. As a result of the circular letter, a total of 15 cases of amebic dysentery were reported from 8 hospitals. No cases of dysentery caused by flagellate protozoans were reported. On account of the absence of the attending physician in military service, the histories of 3 of these cases could not be obtained. Several additional cases were

[4] Ibid., 1918, 156, p. 173.
[5] California State Jour. Med., 1909, 7, p. 199.
[6] Ibid., 1918, 16, p. 240.

reported from other sources, so that finally the desired information concerning 17 cases was secured. Table 1 summarizes such of this information as pertains to place and source of infection.

TABLE 1

SUMMARY OF CASES REPORTED TO THE DIVISION OF PARASITOLOGY

Case	Age, Years	Sex	Foreign Residence or Travel	Place and Source of Infection
1*	..	Male	.....	California. In habit of drinking unboiled water from Sacramento river
2*	..	Male	Probably never out of California	California. Was working in a restaurant when first attack occurred
3	..	Male	In Philippine Islands in 1898	Philippine Islands
4	36	Male	Had been in Porto Rico, Cuba, and the Philippine Islands	Philippine Islands. Became ill while there in 1900
5	11	Female	Born in Honolulu.....	Hawaii. History does not indicate source of infection
6	9	Male	Born in Hawaii.....	Hawaii. "Diet gives no hint of source of infection"
7	..	Male	Had traveled in tropics.....	Probably while in tropics
8	..	Male	From Mexico.....	"No opinion"
9	..	Female	Born in Austria, lived in Japan, 9-4 years ago	History does not show
10	..	Male	In army. In Philippines 4 years	Philippine Islands. Probably drinking contaminated water or eating vegetables irrigated by such water
11*	..	Female	Never been in Orient or tropical countries. Not out of California for long time prevous to infection	California. Probably from vegetables from oriental truck gardeners
12	42	Female	Residence in Hawaii about 18 years ago	Probably in Hawaii
13	..	Male	From Mexico.....	In Mexico
14*	..	Female	Never outside of California...	California. No clue as to source of infection
15*	..	Female	Resident of California all her life	California. No suggestion as to source of infection
16*	31	Male	Born in California and had never been out of state	California. First attack while living at bunk house of mining camp. Probably from food or water
17	36	Male	In Panama, 1906-1911.....	First diagnosis at Colon, Canal Zone

* Disease undoubtedly contracted within the state of California.

Of the 17 cases in table 1, there are 6 in which the disease seems to have been contracted within the state. Residence or travel in tropical countries usually makes absolute establishment of the fact of contraction of the disease within the bounds of the state questionable on account of the possibility of its having remained latent for an indefinite period following infection. When the patient has never been out of the state, however, there is no possibility of question. A definite clue to the mode of infection was hard to obtain, but one of the infections was probably caused by drinking river-water, unboiled (case 1). In another case (case 11), the disease was suspected of having resulted from eating uncooked vegetables from a truck garden

conducted by orientals. This preliminary survey combined with the findings of Long[5] and of Gunn[6] seems to leave no room for doubt that amebiasis has become established in California.

In all of our cases the dysenteric symptoms were sufficiently pronounced so that the patient secured the services of a physician. When the disease is in this acute stage, unencysted, active forms of the amebas are voided almost exclusively. These motile stages of Endameba dysenteriae are very sensitive to change and do not withstand conditions outside the body of the host. So an acute case of amebiasis would be only exceptionally responsible for the spread of the disease. In cases in which the organisms have been introduced into the alimentary tract but have not produced intestinal disturbances, the parasites pass through their normal life cycle, and when voided in the feces have completed encystment so that they are very resistant. Carriers, i. e., those who harbor E. dysenteriae and are voiding cysts but show no dysenteric symptoms, are probably much more common than is generally suspected. Cases of carriers do not ordinarily come to the attention of physicians, and come to light only through extensive routine fecal examinations. Such examinations of a general population are seldom made, and are made in hospitals only on some prompting suspicion. It is suggestive here to review the findings of MacAdam and Keelan[7] among 946 British soldiers, who had served in Mesopotamia. They revealed absolutely no dysenteric symptoms, but 154 persons, or 16.2%, were found to be carriers of E. dysenteriae.

The condition of carrier may also arise following the treatment of acute cases, when the dysenteric symptoms disappear completely and yet the amebas remain in reduced numbers. Where routine examination follows treatment for a month or more a large percentage of "relapses" are found. The relapse may be acute or it may result in making the patient a cyst carrier.

The cases in table 1 give no clue to the problem of cyst carriers in California. The only evidence on this problem locally is that yielded by routine fecal examinations that are being made by the Division of Parasitology of the California State Board of Health of the inhabitants of the "delta region," a rich agricultural district of central California. The survey is only well started, but already a number of cyst carriers of E. dysenteriae, E. coli, E. nana, and G. intestinalis have been found,

[7] Indian Jour. Med. Research, 1917, 5, p. 239.

showing that such carriers do exist within the state. The data so far obtained are insufficient to justify conclusions regarding frequency.

The evidence is sufficient to show that amebiasis is frequently contracted in California and that carriers occur. It is important to consider the conditions that make possible the introduction and spread of this disease into new regions. It is the cyst stage, usually found in persons showing no symptoms of the disease, that makes distribution possible. The cysts of E. dysenteriae are spherical or subspherical, thin walled, greenish-gray in color, and contain from 1 to 4 nuclei and often a refractile chromatoidal body. The chromatin is distributed peripherally in the nucleus with a very distinct karyosome. The cysts vary from 5-20 mikrons in size, but occur in 2 strains, one with an average diameter of 7.7 mikrons and the other with an average diameter of 12.6 mikrons (Smith[8]). Knowledge of respective sizes is quite necessary in the essential matter of distinguishing E. dysenteriae from E. coli and E. nana. A number of recent papers[1, 8, 9, 10, 11, 12, 13] dealing with intestinal protozoa are valuable as an aid in making the necessary distinctions between the cysts of the various forms. The walls of the cysts of E. dysenteriae are very impervious and make fixation and staining difficult. However, either double gram salt solution or Donaldson's stain works very well for diagnostic purposes.

The recent work of Wenyon and O'Connor[12] shows the degree of resistance of the cysts. The cysts of E. dysenteriae apparently do not withstand drying, for after complete drying of the feces they stain at once with eosin. The foregoing authors use this reaction to eosin as an indication of death. In the presence of moisture, however, they continue viable for a long period. They will survive at least one month in polluted water — the less concentration of sewage, the longer the survival. Of the ordinary reagents used in water purification, Wenyon and O'Connor found that chlorinate of lime (1 part Cl in 700,000) had no action on the cysts, free chlorin in 1:10,000 concentration failed to kill in 4 hours. Carbolic acid (1:40) killed in 15 minutes, while 1:100 was lethal after 7 hours. Cresol, 1:20, killed immediately. Emetin hydrochlorid, 1:200, failed to kill the cysts in 9 hours, though a strength of 1:10,000 will kill the ameba in the active stage.

[8] Ann. Trop. Med. & Parasitol., 1918, 12, p. 27.

[9] Matthews, J. R.: 1918 Observation on the Cysts of the Common Intestinal Protozoa of Man, Ann. Trop. Med. & Parasitol, 1918, 12, p. 17.

[10] Dobell, A., and Jepps, M. W.: Brit. Med. Jour., 1917, 1, p. 607.

[11] Knowles, R., and Cole, A. F.: Indian Jour. Med. Research, 1916, 4, p. 498.

[12] Kofoid, Kornhauser, Swezy, Arch. Int. Med. 1919, 24, p. 35.

[13] Human Intestinal Protozoa in the Near East, 1917.

This brief summary of the resistance of the cysts of E. histolytica indicates to some extent those climatic and sanitary conditions that favor the spread of the disease. Countries with long, dry seasons, or those with long periods with temperature below the freezing point will find in natural conditions a considerable check on the distribution. However, conditions might occur in almost any country at almost any time under which there would be sufficient moisture and a high enough temperature to make possible the transfer of the cysts in a viable condition from one person to another.

The long survival of the cysts in water is one of the most important factors in the spread of amebiasis. Many streams receive untreated sewage from villages and cities, and from many such rivers, water is taken at points below for drinking purposes. When cities are using such water, bacterial examinations are usually made to determine its fitness, but these give no clue to the presence of the cysts of Giardia or Endamoeba; but when such water is used by individuals for household purposes it is unusual to make any tests whatever, and in many instances the water is drunk without boiling or treatment. Such conditions would seem to be admirable for the spread of intestinal protozoa.

Unpotable water used for irrigation purposes may also aid in distribution, for the sources of such water are given little attention. Not infrequently irrigation ditches are the most convenient means for sewage disposal. People working on tracts supplied by ditches so used are likely at times to come in contact with the water, and the introduction of the cysts into the mouth is not at all impossible.

Another way in which irrigation water may become an indirect factor is in its use in truck gardening. The use of polluted water or sewage in the irrigation of such vegetables as lettuce, celery, watercress, cabbage, etc., which are eaten uncooked, is a serious menace. Within the state are large areas devoted to truck gardens, a large part of which are in the charge of orientals or employ oriental labor. In the countries from which these people come amebic dysentery is common, and undoubtedly many carriers enter the United States and engage in the raising of small fruits and vegetable. In many oriental countries, on account of the necessity for intensive cultivation, the use of human excreta as fertilizer has been a common procedure. Employment of this method of fertilization in the state of California has been a sufficiently common practice to prompt the California State Board

of Health[14] to pass resolutions prohibiting its continuance in the production of vegetables, berries and low-growing fruits. Even after effective measures against this procedure have been taken, there still remains the danger of contamination of garden truck through cultivation and handling by carrier of E. dysenteriae.

The employment of such carriers in connection with the preparation of food in private homes or in public eating houses might also make possible the spread of amebiasis. Typhoid fever and bacillary dysenteries are known to be spread in this way and the conditions are equally favorable for the spread of amebic dysentery.

In addition to the factors mentioned, one other has recently been brought to attention by the work of Wenyon and O'Connor.[12] House flies fed by them on infected feces were found to pass living, apparently unchanged E. dysenteriae cysts during a period beginning 5 minutes after ingestion and continuing as long as 42 hours. They also examined between 200 and 300 wild flies and found about 8% carrying cysts of human intestinal protozoa, beside eggs of flukes, tapeworms and nematodes, commonly parasitic in the intestine of man. Over 3% carried cysts of E. dysenteriae. These flies were taken in a city where sanitary conditions were anything but good.

California is unique in having certain conditions and combinations of conditions favorable to the spread of amebic dysentery. Within the state are large numbers of people from countries where the disease is prevalent, many of whom are undoubtedly carriers. A large majority of these engage in agriculture, in the form of truck gardening, or become cooks and domestic servants. The state also has extensive irrigated areas that are seldom, if ever, visited by a considerable period of freezing temperatures.

California is also uniquely situated with respect to the introduction of the disease. Yearly there have come in a large number of immigrants, the greater part of whom have settled in the state. These immigrants have come principally from Japan, China, and India, where intestinal protozoa are common. Travel to and from the Hawaiian and Philippine Islands takes place through the ports of California. It is also likely that a larger percentage of Californians than of citizens of any other state visit these islands. This affords an important source for introduction of amebic dysentery as is indicated by numbers 3, 4, 5, 6, 10 and 12 of table 1. Into the southern part of the state there is

[14] California State Board of Health, Monthly Bull., 1918, 13, pp. 451 and 461.

a large immigration of Mexican laborers. They no longer settle solely within the southern counties, but are becoming generally distributed throughout the state. There is also considerable travel to and from Mexico and the Central American States, due to mining interests and the operation of the Panama Canal. Introduction from these regions is undoubtedly frequent, as illustrated by cases 8, 13 and 17 of table 1.

The opportunities for the introduction and spread of E. dysenteriae in California are such that this parasite is probably much more prevalent than records show, and may become a serious menace not only to the state, but to the whole country.